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## To cite this version:

Claude Camy-Peyret, Jérôme Bureau, Sébastien Payan. Comparison of CO2 retrievals from IASI-A, IASI-B and GOSAT in the thermal infrared for nearly coincident measurements over the Arctic ocean in summer. European Geosciences Union General Assembly 2015, Apr 2015, Vienne, Austria. hal-01142231

**HAL Id: hal-01142231**

**https://hal.science/hal-01142231**

Submitted on 1 Mar 2022

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Geophysical Research Abstracts
Vol. 17, EGU2015-13599, 2015
EGU General Assembly 2015
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# Comparison of $CO_2$ retrievals from IASI-A, IASI-B and GOSAT in the thermal infrared for nearly coincident measurements over the Arctic ocean in summer

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The capabilities to retrieve reliable information on the concentration of greenhouse gases in the lower atmosphere from thermal infrared (TIR) spectra collected by nadir sounders is still to be assessed. We have selected the two months period of July-August in the high latitude polar region where it is possible to observe almost coincident or superimposed footprints (IFOV) of the three infrared sounders considered in this study, namely IASI-A, IASI-B (on the MetOp platforms) and TANSO-FTS (on GOSAT). Retrievals of the column averaged mixing ratio of carbon dioxide $XCO_2$ (and of the surface temperature) have been performed for three years i.e. 2010, 2013 and 2014 over Arctic waters. The summer period was chosen because ice free IFOVs (in the latitude band 68N to 82N) can be selected for which retrievals are less sensitive to surface inhomogeneity (as compared to IFOVs located over land). The emissivity of sea water is also better constrained. The inversion configuration (using the atmospheric window covering the so-called $CO_2$ laser band in the interval 940-980 $cm^{-1}$) will be described. The sensitivity of the retrieved $XCO_2$ to the different layers of the lower atmosphere as a function of thermal contrast, temperature and humidity profiles will be presented. The precision/accuracy of the retrieved $XCO_2$ will be discussed and compared between sounders. The $CO_2$ trends is clearly captured over the years analysed in this work. The retrieved values will be compared to similar $XCO_2$ products available from other sources (Leicester Univ., NIES, SRON/KIT). Some remaining spectroscopic issues in the vicinity of 948 $cm^{-1}$ have been identified and circumvented. The retrieved sea surface temperature $T_{surf}$ used as a control variable is also providing an additional check of the performances of the retrievals and is compared to the Eumetsat IASI $T_{surf}$ product. These results are interesting starting points for preparing future missions like IASI-NG on MetOp-SG as well as GOSAT-2.